KU /12 APP /6 TIPS /12

Celestial Mechanics Quiz Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Part A: True or False [12 marks]**

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| 1. The total energy of each of the planets in our solar system is negative. |  |
| 1. The gravitational energy of a pencil on a desk is higher than the gravitational energy of a pencil on the floor. |  |
| 1. As a penny falls, its binding energy decreases |  |
| 1. As a penny falls, its gravitational energy decreases |  |
| 1. As a penny falls, its total energy decreases |  |
| 1. To raise a book up to a high bookshelf takes work. |  |
| 1. Binding energy is zero if the total energy of the system is positive. |  |
| 1. Binding energy is the work done raising an object from one height to another. |  |
| 1. A football thrown during a football game has a binding energy that is less than its kinetic energy. |  |
| 1. A person on the first floor has a higher binding energy than the same person on the tenth floor. |  |
| 1. On an ideal rollercoaster, the total energy of the cart is greatest at the top of the highest hill. |  |
| 1. On an ideal rollercoaster, the total energy of the cart is greatest at the bottom of the highest hill. |  |

**Part B: Application [6 marks]**

1. A geology satellite of mass 3500kg orbits at an altitude of 185km above the Earth's surface. Find the speed of the satellite. [3]
2. The moon has a mass of 7.35x1022kg and a radius of 1.738 x 106m. Find the work done to lift a 30kg mass from the ground to a height of 75m on the moon. [3]

**Part C: Thinking Questions [12 marks]**

1. Let A and B be two negative numbers. A is half of B. Which number is higher? [1]
2. Prove that the orbital speed of any satellite on a planet of mass M and radius R is given by [2]
3. I have an eraser of mass 30g and a text book of mass 1.5kg on my desk.
4. According to the universal formula, which item has a higher Eg? [1]
5. Use your understanding of binding energy to explain why your answer to a) makes sense. [1]
6. Suppose my desk is 1.0m tall. Show without calculating any values that the textbook would have more kinetic energy than the eraser if they both fell to the ground. [1]
7. Prove that Ek = -1/2 Eg for a satellite in orbit. [3]
8. A problem asks to find the work done to lift an object on Earth. Bart calculates it using the local formula (W = ΔEg = mgh). Lisa calculates it using the universal formula.
9. whose answer is more correct? [1]
10. which answer is greater? [1]
11. To calculate the work done to lift an object, the formula we used in grade 11 was Eg = mgh. Now we learn that work is ΔEg, not Eg. Why could we ignore the delta in grade 11? [1]